

April 27, 2005

TO: Eugene Burke  
FROM: J. Retana  
SUBJECT: Solar-TERrestrial RELations Observatory Ahead and Behind (STEREO A & B)  
Study of Increased Support February 2006 through May 2006

STEREO will employ two nearly identical space-based observatories known as STEREO Ahead (STA) and STEREO Behind (STB). STA and STB will be in a heliocentric orbit about the sun; one drifting ahead of the earth and one drifting behind the earth.

The purpose of this study is to evaluate STA's and STB's additional attenuator, maneuver, backup maneuver and phasing requirements based on the updated requirements received from the STEREO Project on January 21, 2005 which were not considered during the February 2005 Resource Allocation Review Board (RARB).

Analysis was accomplished using the FASTER (forecasting and scheduling tool for earth-based resources) forecasting system and the updated mission set database from the February 2005 RARB.

### **Summary**

The analysis is performed for the period February 11, 2006 through May 21, 2006 to assess the DSN network loading and contention during this period. STA and STB are each requesting a 2-hour backup support for each maneuver and an increase of daily contact during the phasing orbits from 3 hours to 12 hours daily. Based on the current launch and early operations priorities, STA and STB are forecast to receive greater than 90 percent supportability. Because there is only two antennas at each complex planned to have attenuators installed and maneuvers for missions are at nearly the same time, there aren't enough antennas to support requested backup antennas. RAPSO is recommending that maneuver backup antenna supports be deleted.

### **Assumptions for Feb 2006 – May 2006**

MRO Approach, MOI, Aero-Braking January 2006 through November 2006  
New Horizons Launch January 2006 and Early Ops phase through March 2006  
ST5 Launch 28 February 2006  
SOHO Keyhole 21 February 2006 through 22 March 2006  
Stardust Post Earth Return phase ending 15 February 2006  
STEREO Ahead and Behind scheduled to launch on 11 February 2006  
Venus Express Approach phase February through April 2006

## Requirements

STA's requirements increased by 349 hours, STB's requirements increased by 189 hours and the Initial Acquisition and launch supports for both STA and STB decreased by 6 hours. The total requirements for both STA and STB were increased by 532 hours in week 6 through week 20 since the last ULP update received on January 21, 2005. (See Figure-1) The increase is due to the additional set-up and teardown times for Initial Acquisition, attenuator and maneuver backup passes. Phasing requirements increased the amount of support for each spacecraft from 3 hours per day to 12 hours per day in weeks 8 – 13.

Based on the "Signal Attenuator Implementation Proposal" the proposed stations that will use the attenuators will be: DSS-65, DSS-55 at MDSCC; DSS-34, DSS-45 at CDSCC; and DSS-15, DSS-25 at GDSCC. The preference is to install the attenuators at the 34M BWG and the 34M HEF subnets; the 34HEF are to be used for backup for nominal coverage. Complex personnel will need to know well in advance exactly when each pass is scheduled to ensure the attenuators are installed and uninstalled in a timely manner. Presently, the passes needing attenuators are currently planned to be 8 hours in length with a 1 hour, 45 minute setup and a 1 hour, 15 minute teardown. The total duration will be 11 hours. The updated ULP states that the attenuator passes are scheduled to occur in weeks 8, 10, 12 and 14, one pass per week.

	wk6	wk7	wk8	wk9	wk10	wk11	wk12	wk13	wk14	wk15	wk16	wk17	wk18	wk19	wk20	Total
STA Previous Request 34H	21	2	1	0	2	0	3	0	0	0	0	0	0	12	0	41
STA Current Request 34H	9	2	3	0	4	0	3	0	0	0	0	0	0	12	0	33
Difference	-12	0	2	0	2	0	0	0	0	0	0	0	0	0	0	-8
STA Previous Request 34B1	35	48	23	15	10	14	24	14	11	9	10	19	12	27	14	285
STA Current Request 34B1	24	50	36	52	27	31	39	30	17	9	10	19	12	27	14	397
Difference	-11	2	13	37	17	17	15	16	6	0	0	0	0	0	0	112
STA Previous Request 34B2	31	129	57	39	44	39	53	39	43	20	20	34	18	14	19	599
STA Current Request 34B2	31	133	87	62	94	84	92	85	51	20	20	34	18	14	19	844
Difference	0	4	30	23	50	45	39	46	8	0	0	0	0	0	0	245
STA/STB Init Acq Previous Request 26M	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	11
STA/STB Init Acq Current Request 26M	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Difference	-6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-6
STB Previous Request 34H	13	44	17	14	14	14	22	14	7	0	0	0	0	0	0	159
STB Current Request 34H	13	46	22	41	37	30	25	23	11	0	0	0	0	0	0	248
Difference	0	2	5	27	23	16	3	9	4	0	0	0	0	0	0	89
STB Previous Request 34B1	19	60	29	20	21	20	28	20	23	23	22	23	23	23	23	377
STB Current Request 34B1	19	62	30	19	26	40	31	32	34	23	22	23	23	23	23	430
Difference	0	2	1	-1	5	20	3	12	11	0	0	0	0	0	0	53
STB Previous Request 34B2	9	59	35	19	21	19	31	19	24	10	11	11	10	10	10	298
STB Current Request 34B2	9	61	42	18	27	40	34	29	23	10	11	11	10	10	10	345
Difference	0	2	7	-1	6	21	3	10	-1	0	0	0	0	0	0	47
<b>GrandTotal</b>																
STA Previous Request Total	925															
STA Current Request Total	1274															
Difference	349															
STB Previous Request Total	834															
STB Current Request Total	1023															
Difference	189															

Figure 1

## Analysis

Due to STA and STB sharing nearly the same view period and the remaining resources available, STA and STB will find it difficult to obtain maneuver backup support at CDSCC and at MDSCC. If STA and STB maneuvers are being supported at DSS-34 and DSS-45, there are no remaining resources available at CDSCC to provide maneuver backup support. Due to complete view period overlap and only one antenna resource remaining at MDSCC, maneuver backup support can only be provided to either STA or STB.

If attenuators are not required, STA and STB could receive Maneuver Backup support at GDSCC and MDSCC; however, Cassini (CAS), Chandra (CHDR), Mars Express Orbiter (MEX) and Mars Reconnaissance Orbiter (MRO) will be adversely impacted at DSS-24, DSS-26 and DSS-54. The 70 meter antennas (DSS-14, DSS-43 and DSS-63) are not viable alternatives since the 70 meters are too powerful and do not have attenuators to reduce transmitter and received power levels during this period.

The primary view for Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) is CDSCC, specifically at DSS-34 for nominal daily coverage. If STA and STB use DSS-34 for any extended length of time, IMAGE would need simultaneous passes at DSS-45 for Downlink and at DSS-46 for Uplink compounding the contention at CDSCC. STA and STB also have significant view period overlap with Space Technology 5 (ST5) at DSS-34.

The contention throughout this period is caused by Stardust Post Earth Return operations, New Horizons Early Operation continuous supports, ST5 Launch, STA and STB Maneuver Backup supports and is compounded by view period overlap with Cassini. SOHO Keyhole events will also be in contention around maneuvers.

### **View Period Assessment of the Project Coverage February 2006 through May 2006**

The view periods for STA & STB will overlap each other nearly 100 percent from launch in week 6 through week 17. From week 18 to the 2<sup>nd</sup> lunar swing-by in week 20 of 2006, the view periods will separate gradually. In week 20 of 2006 STA will perform a lunar swing-by that will put STA in a different orbit.

The view period overlap between STA and STB and the MARS projects is 50 to 90 percent and 90 to 100 percent with Cassini. Other projects with significant view period overlap are CHDR, Cluster 1 – 4, Polar, IMAGE, New Horizons Pluto/Charon (NHPC), Voyager 1 & 2, ST5 and SOHO during its keyhole period in weeks 8 – 12.

***Please review the view period overlap illustrations attached with this document.***

### **Conclusion**

Due to STA and STB sharing nearly the same view period and requesting nearly simultaneous support with the remaining resources available, STA and STB will find it difficult to obtain maneuver backup support. If STA and STB maneuvers are being supported at DSS-34 and DSS-45, there are no remaining resources available at CDSCC to provide maneuver backup support. Due to complete view period overlap and only one antenna resource remaining at MDSCC, maneuver backup support can only be provided to either STA or STB and that antenna would not have attenuators. There are enough antennas (none with attenuators) at GDSCC for STA and STB to receive Maneuver Backup; however, CAS, CHDR, MEX and MRO will be adversely impacted at DSS-24 and DSS-26. DSS-14, DSS-43 and DSS-63 (70 meters) are not viable alternatives since the 70 meters are too powerful and do not have attenuators to reduce the transmitter and received power levels. Therefore, RAPSO recommends the project to delete maneuver backup support.

The primary view for IMAG is CDSCC, specifically at DSS-34 for nominal daily coverage. If STA and STB use DSS-34 for any extended length of time, IMAG will need simultaneous passes at DSS-45 for Downlink and DSS-46 for Uplink compounding the contention at CDSCC, this is not preferred by IMAG. STA and STB also have significant view period overlap with ST5 at DSS-34.

The contention in this period is caused by ST5 Launch, New Horizons Early Operation continuous supports, Stardust Earth Return operations, STA and STB Backup Maneuver supports and is compounded by view period overlap with Cassini. SOHO Keyhole events will also be in contention.

Based on the above-mentioned conclusions and current launch and early operations priorities STA and STB are forecast to receive greater than 90 percent supportability. While RAPSO recommends that maneuver backup support be deleted, STA and STB could use two downlink channels as a backup for the maneuvers at CDSCC, MDSCC and at GDSCC if additional reliability is sought.

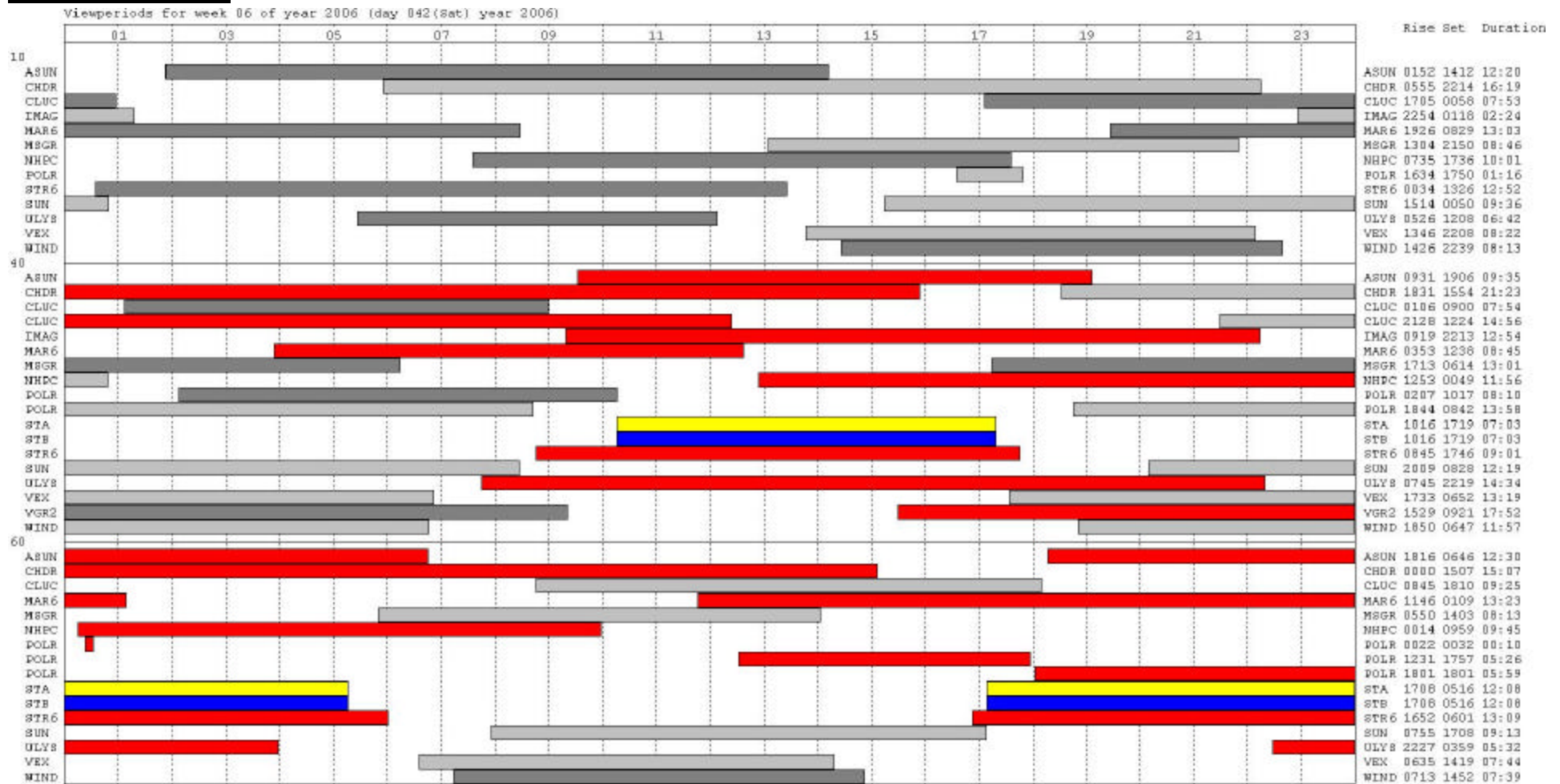
RAPSO will continue to work with STA and STB and other users of the DSN to maximize the time available for each individual user.

The results of this study are preliminary in that network loading changes as requirements for planned missions are updated.

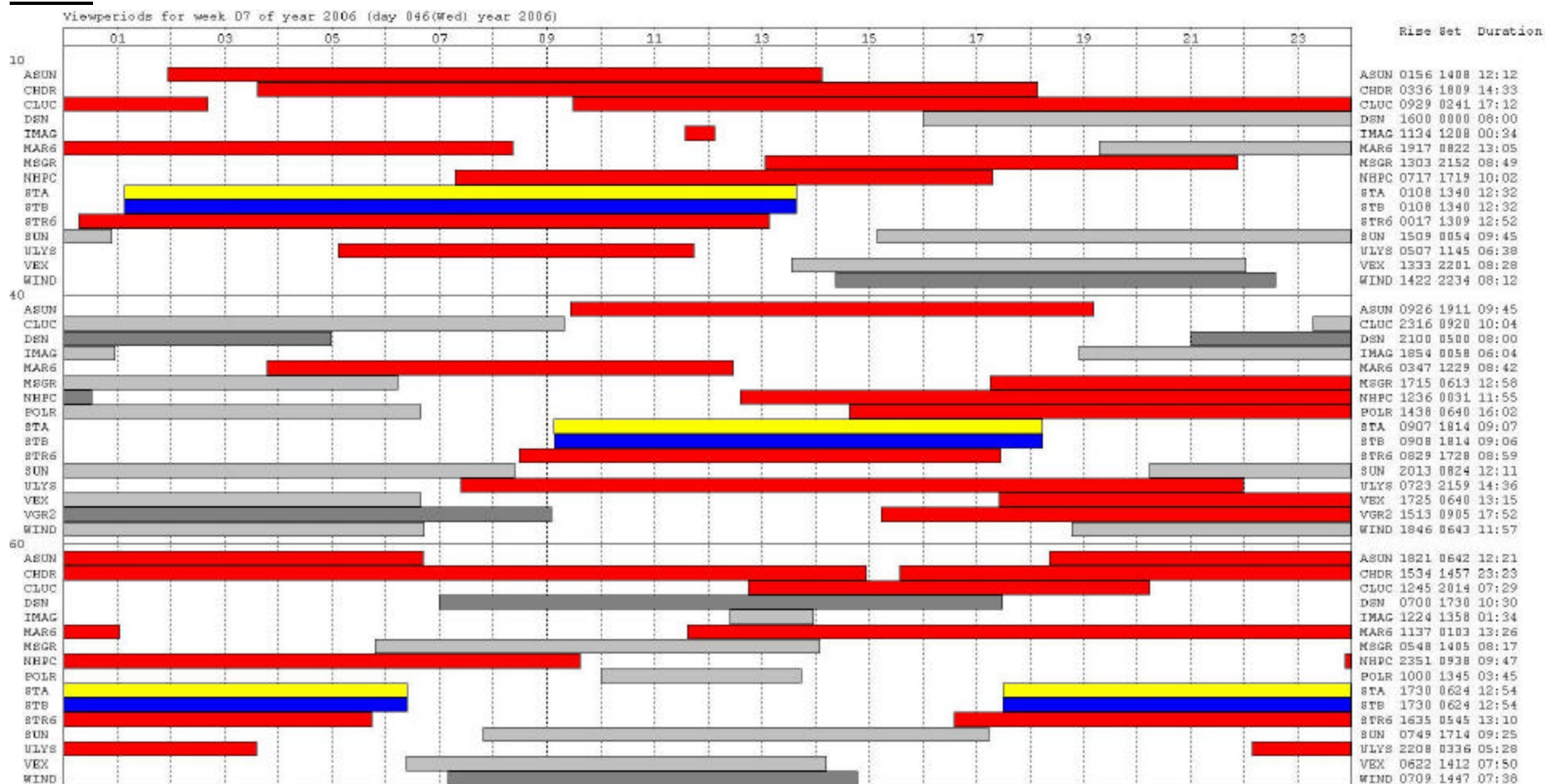
Cc:	E. Hampton	D. Ossing
C. Abramo	N. Lacey	S. Riley
A. Andujo	M. Medina	N. Satterlee
G. Burke	D. Morris	J. Wallick
S. Guduru	L. Nguyen	

The attached view period overlap illustrations are for Launch Day in Weeks 6, Week 7 and Weeks 18 through 20. STA is represented in YELLOW and STB is represented in BLUE and projects in contention are illustrated in RED. Cassini's view period indicator is STR6 and the Mars projects as MAR6.

## Week 6 Launch Day



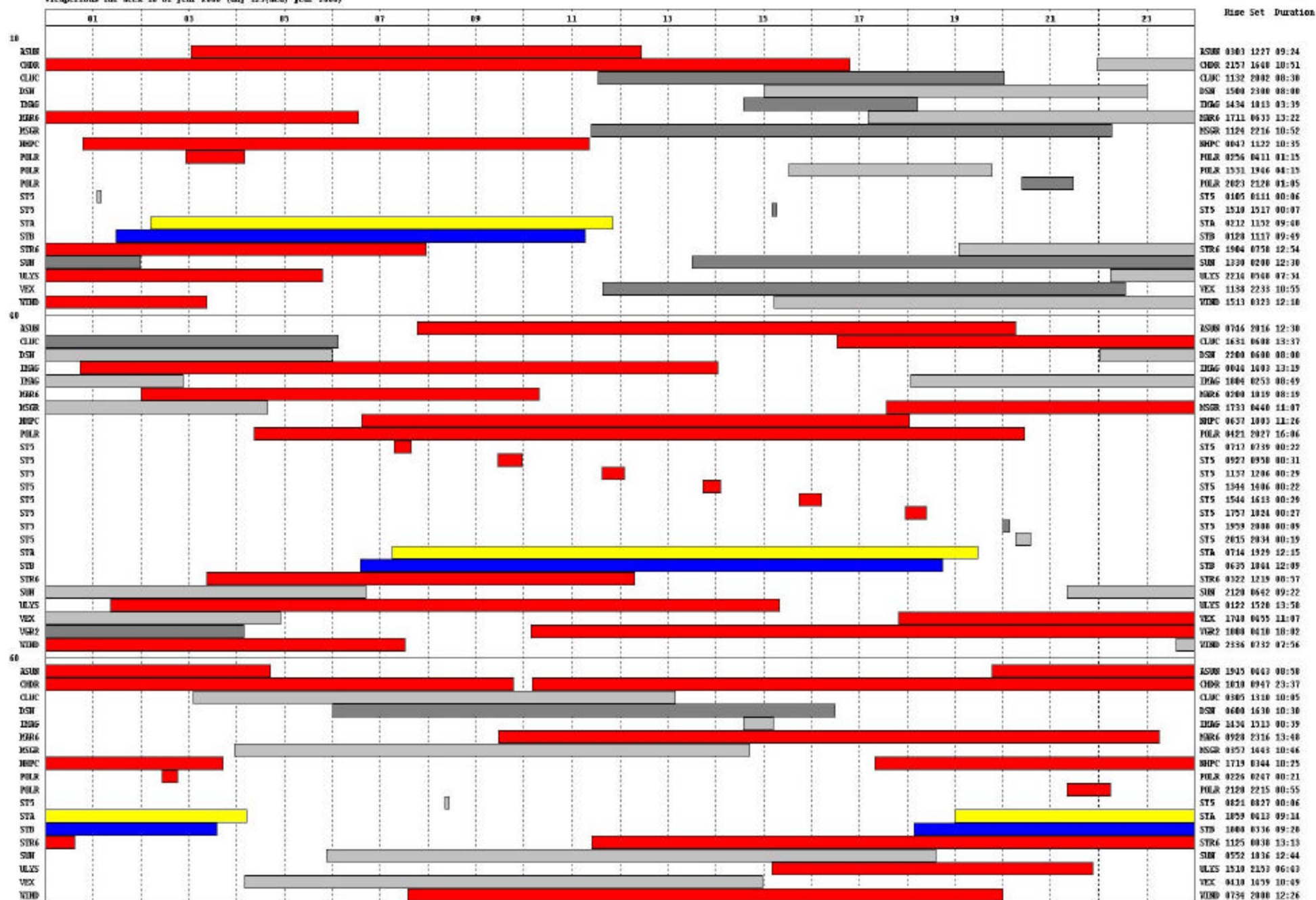
## Week 7



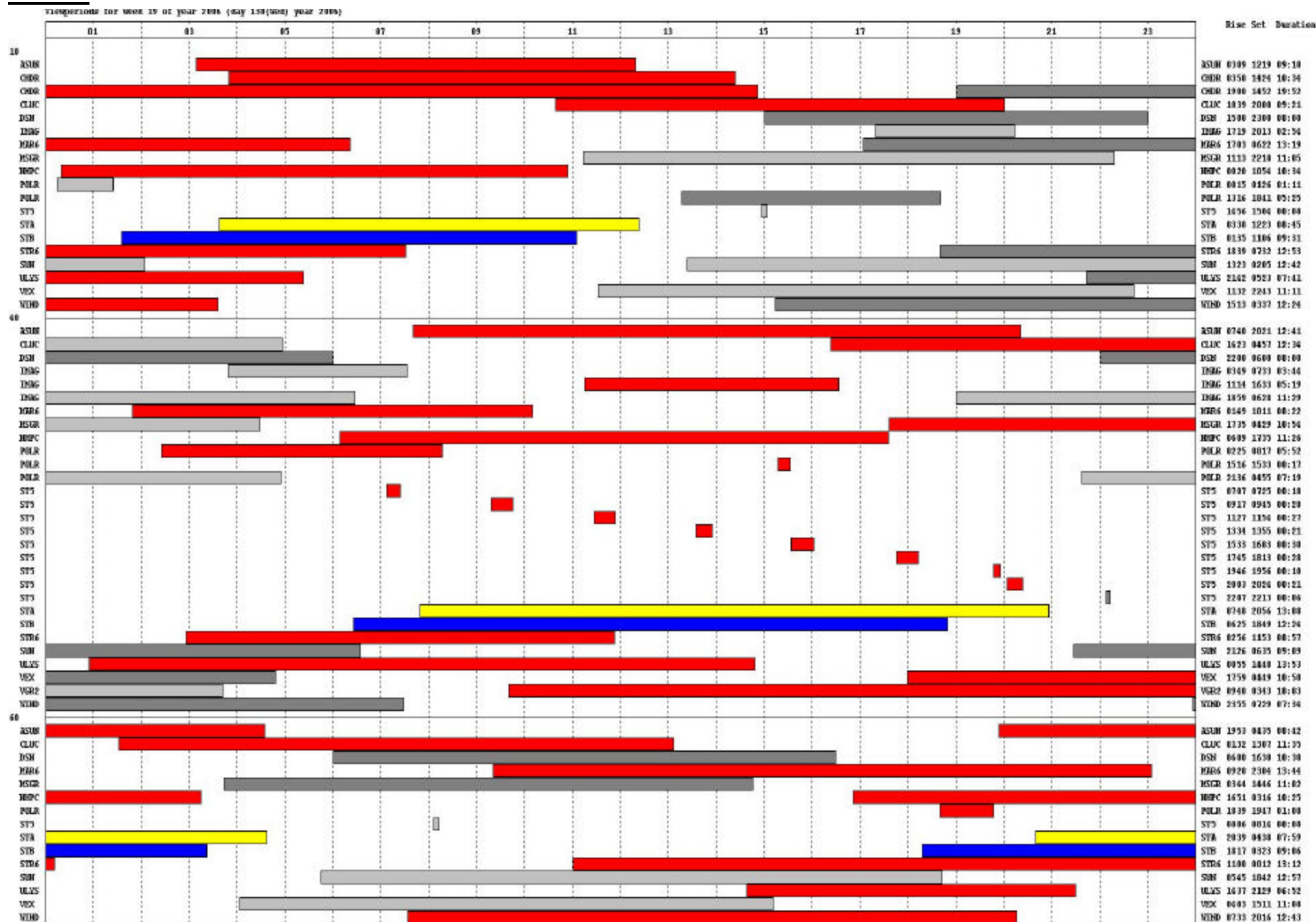


# Week 18

Viewperiods for week 18 of year 2066 (day 123(Thu) year 2066)



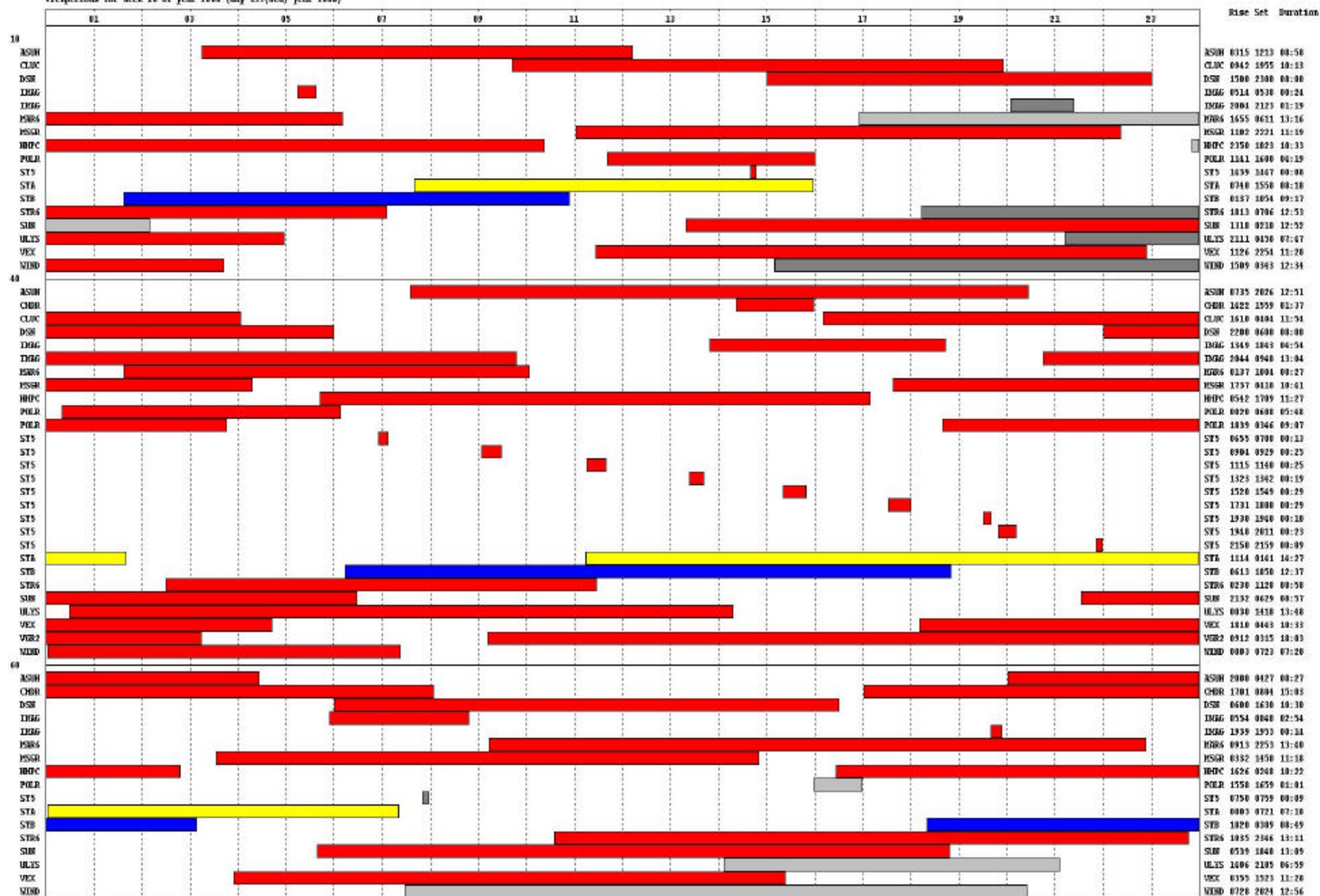
# Week 19





# Week 20

Viewperiods for week 20 of year 2006 (day 137(Wed) year 2006)



### Previous and Current STEREO Ahead User Loading Profile

## Previous STEREO Ahead ULP for 2006

[illegible]

## Current STEREO Ahead ULP for 2006

[illegible]

### Previous and Current STEREO Behind User Loading Profile

## Previous STEREO Behind ULP for 2006

[illegible]

## Current STEREO Behind ULP for 2006

[illegible]